Characteristics of Io's Far-UV Neutral Oxygen and Sulfur Emissions Derived from Recent HST Observations

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At the time of discovery with the IUE satellite of the far-UV O and S emissions from Io's atmosphere, because of lack of adequate data on the electron impact excitation of O and S, excitation of a neutral corona by the torus electrons could not be established, and a possible ionospheric excitation of O and S or of SO_2 was suggested. Subsequent improved atomic data later re-instated the possibility of the torus coronal excitation. An eclipse observation with HST (FOS) later revealed a large decrease in the emission intensity with shadow, favoring an ionospheric excitation with the time scales for SO_2 condensation and/or ionospheric recombination. Here we present results from HST/GHRS observations made on 1993-1996. Of a number of HST eclipse observations, only one ingress observation show a substantial decrease with shadow, while the others show a rather mild dependence. Large temporal variations are observed while in sunlight, some with times scales on the order of 10 minutes, indicating that other temporal factors are at play. The emissions are usually enhanced when Io is in the densest part of the torus, but observations in 1996 have surprisingly shown the opposite dependence on the torus. New spectroscopic evidence now strongly indicates that electron excitation of neutral O and S produces the bulk of the emission, rather than electron dissociative excitation of SO_2. Spatial scans of the emissions have also revealed that the emissions indeed extend out to about r $\sim$ 2 RIo. There are also significant E-W and N-S asymmetries, though these show temporal and/or torus dependency. A more extended emission also observed by S^+ ions, with asymmetries anti-correlated to those of the O and S emissions. Models of the distribution of the emissions will be presented. The large extent of the neutral emissions may reflect the large extent of the corona, but the extension of the ionosphere and processes is still not well established in the light of the new Galileo observations. We will also present observations made with the HST/FOS of Io's leading and trailing hemispheres that show the $\sim$2100 Å of Io's disk-integrated SO_2 atmosphere.

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